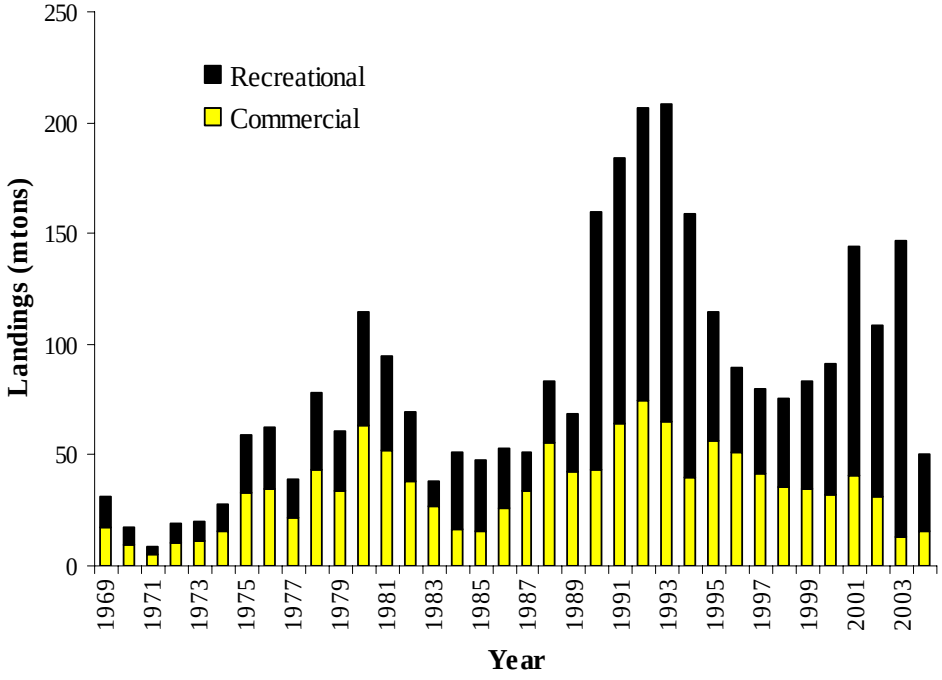
Executive Summary

Stock: This is the first assessment of gopher rockfish (*Sebastes carnatus*) and is restricted to the portion of the stock north of Point Conception (lat. $34^{o}\,30'$ N). There is evidence that supports differences in size and growth of gopher rockfish in southern California that indicates the need for a separate assessment on the southern California segment. Life history information for the southern segment is not known.

Catches: Catches of gopher rockfish in northern California (north of Point Conception) were classified into two fisheries, commercial and recreational. Gopher rockfish are primarily taken with hook-and-line gears in both fisheries. Commercial landings from 1969-1977 came from California's Commercial Fisheries Information System (CFIS, landing receipts). From 1978-2004, California Cooperative Survey (CALCOM) expansion estimates were used. There were minimal, if any, landings reported in the commercial fishery from 1984-1988. The assumption was made that this was due to the introduction of the group gopher market category during that time. Therefore, we applied CALCOM species compositions in the 1980s to CFIS landings for estimates in those years. Recreational landings from 1969-1982 were estimated by ratio of sums to commercial landings in the 1980s time period. From 1983-2004, Recreational Fisheries Information Network (RecFIN) estimates for gopher rockfish were used. There were no estimates in RecFIN from 1990-1995 data for Commercial Passenger Fishing Vessels (CPFVs) and no 1990-1992 estimates for shore-based and private boats. Therefore, we used CPFV estimates from the Northern and Central California CPFV Sportfish Survey (CDFG) while estimates for shore-based and private boats were based on historical averages from 1990-1992. Estimated discards were included in the recreational catches.

Recent Gopher Rockfish Landings (mtons)

	Commercial	Recreational
1990	43	116
1991	64	120
1992	74	132
1993	65	143
1994	40	119
1995	57	58
1996	51	38
1997	42	38
1998	36	40
1999	35	49
2000	32	59
2001	40	104
2002	31	77
2003	13	134
2004	15	35

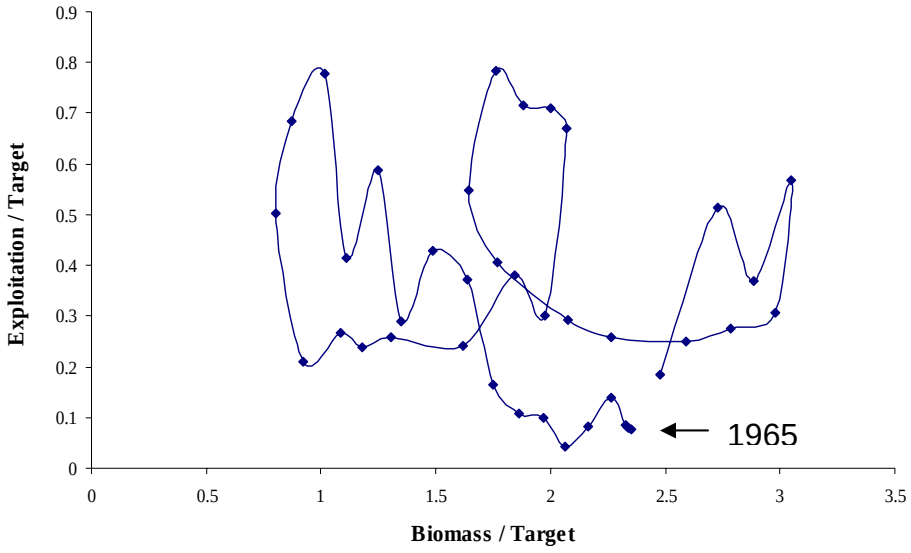


Data and assessment: This is the first evaluation of gopher rockfish. Input data consisted of the following sources: 1) commercial landings and length compositions from the CFIS and CALCOM databases, 2) recreational landings and length compositions from the RecFIN database, and 3) length compositions and recreational CPFV catch per unit effort (CPUE) statistic derived from CDFG's Northern and Central California CPFV Sportfish Survey database. These data sources were used to estimate the population characteristics from the time period 1965 to 2004 in the length-based model of Stock Synthesis 2 (v1.19). The initial pre-1965 conditions were based on 1969-1974 averages for each fishery. Recruitment deviations were estimated from 1965-2000. Selectivity patterns were fixed external to the model after length compositions were evaluated. Growth and other life history parameters were fixed in most cases, primarily based on Lea et al. (1999). Spawner-recruit steepness was fixed (h=0.65) and variability was also held constant (sigma r = 0.5).

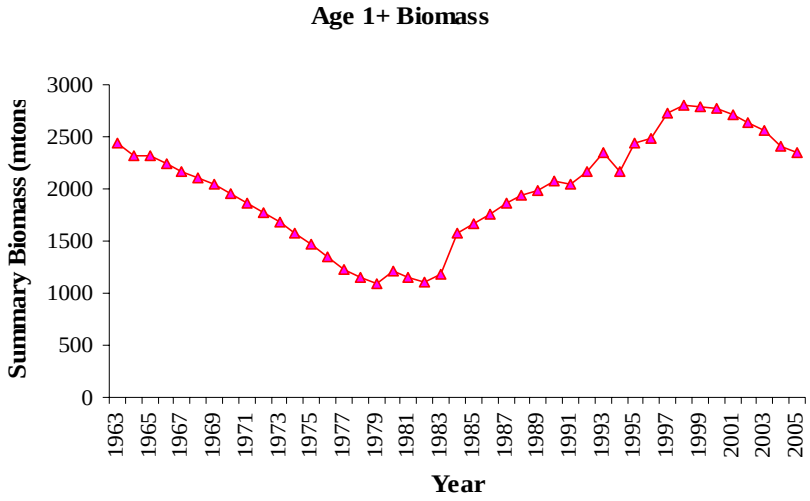
Unresolved problems and uncertainties: The major area of uncertainty the Stock Assessment Review (STAR) Panel and Stock Assessment Team (STAT) agreed upon was the bounding scenarios of the baseline model using the CPFV survey CPUE index for a measure of relative abundance, which brings into question the accuracy of abundance trends derived from this series of information. The emphasis on this data source (with associated relative probabilities in parenthesis) was set at 1 (0.22), 5 (0.40) and 10 (0.38), with 5 being the most likely scenario and used in the baseline model.

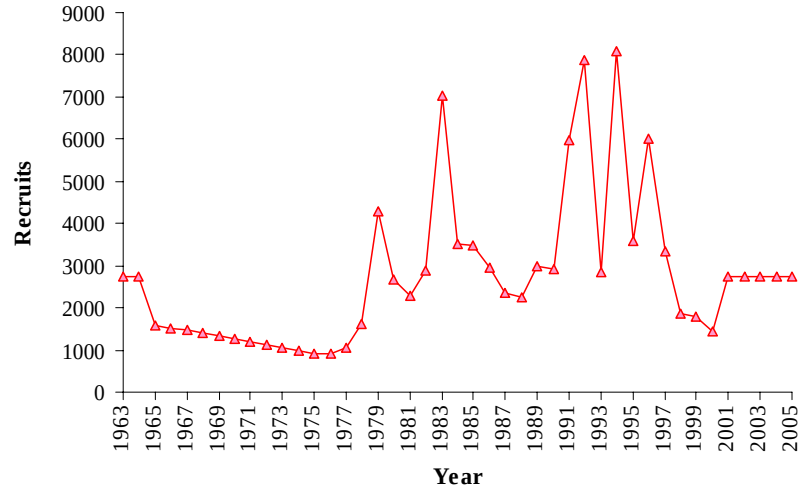
Reference points: Like many rockfish species, the target harvest rate for gopher rockfish is $F_{50\%}$, based on the Pacific Fishery Management Council's (PFMC) guidelines. The following reference points were obtained from the baseline model (emphasis 5 on the CPUE index).

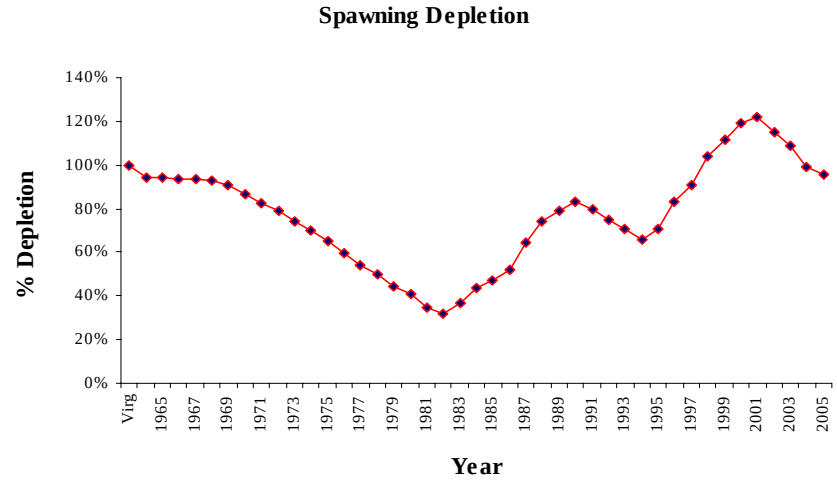
Biological Reference Points		
Unfished spawning biomass (SB_0)	1,995	mtons
Unfished summary (age 1+) biomass (B_0)	2,440	mtons
Unfished recruitment (age 0) (R_0)	2,758	mtons
2005 spawning biomass (SB_{2005})	1,931	mtons
2005 summary (age 1+) biomass (B_{2005})	2,385	mtons
ABC ($F_{50\%}$ * B_{2005})	246	mtons
$SB_{40\%}$ (MSY proxy stock size = 0.4 * SB_0)	798	mtons
Exploitation rate at MSY (rockfish proxy $F_{50\%}$)	10.3	%
MSY ($F_{50\%}$ * 40% * B_0)	101	mtons



Stock biomass: Biomass time series (summary biomass (age 1+), recruitment (age 0), and spawning depletion) for gopher rockfish north of Point Conception produced from the baseline assessment model.







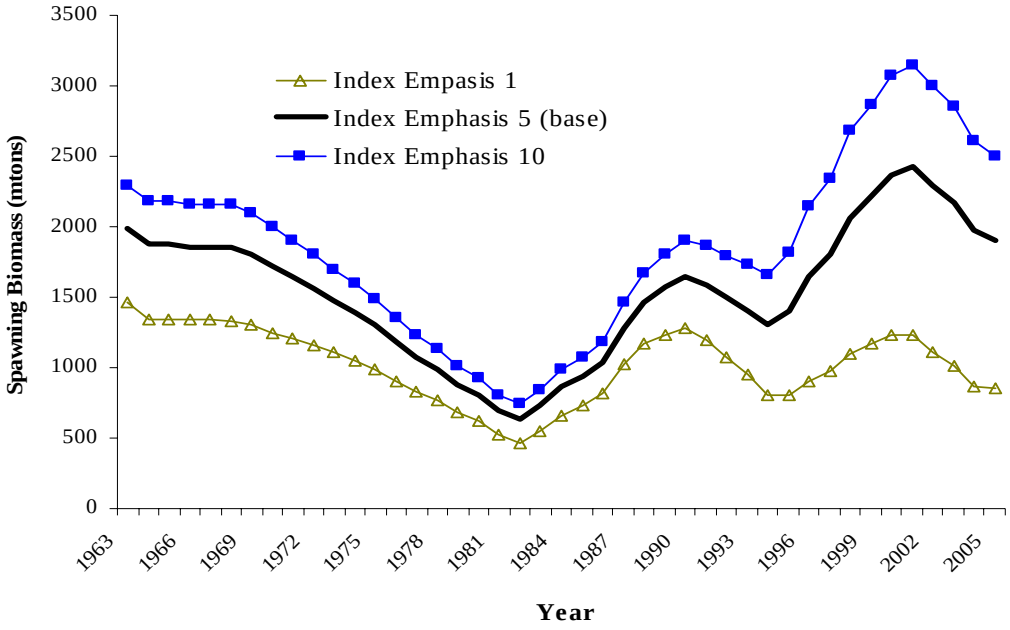
Time series of stock biomass, recruitment, and exploitation rates (1990-2005) produced from the baseline assessment model.

	Total (Age 0+) Biomass	**Age 1+ Biomass**	**Spawning Biomass**	**Age-0 Recruits**	**Commercial Catch**	**Commercial Harvest Rate**	**Recreational Catch**	**Recreational Harvest Rate**	**Spawning Stock Depletion**
virgin	***2,663***	***2,440***	***1,995***	***2,758***	**--**	**--**	**--**	**--**	***100%***
1990	2,318	2,083	1,651	2,917	43	6.1%	116	13.7%	83%
1991	2,530	2,048	1,594	5,973	64	8.5%	120	14.0%	80%
1992	2,804	2,170	1,498	7,863	74	10.0%	132	16.0%	75%
1993	2,588	2,358	1,406	2,861	65	9.5%	143	19.1%	71%
1994	2,822	2,171	1,312	8,073	40	6.4%	119	17.8%	66%
1995	2,735	2,443	1,408	3,613	57	9.8%	58	9.1%	71%
1996	2,980	2,492	1,656	6,048	51	8.7%	38	5.6%	83%
1997	3,007	2,734	1,806	3,378	42	6.4%	38	4.9%	91%
1998	2,964	2,814	2,065	1,871	36	4.6%	40	4.3%	104%
1999	2,941	2,796	2,219	1,799	35	3.8%	49	4.5%	111%
2000	2,898	2,782	2,376	1,440	32	3.1%	59	4.9%	119%
2001	2,947	2,725	2,432	2,745	40	3.5%	104	7.9%	122%
2002	2,888	2,666	2,327	2,750	31	2.6%	77	5.8%	117%
2003	2,814	2,592	2,201	2,751	13	1.0%	134	10.2%	110%
2004	2,666	2,444	2,002	2,754	15	1.2%	35	2.8%	100%
2005	2,607	2,385	1,931	2,746	--	--	--	--	97%

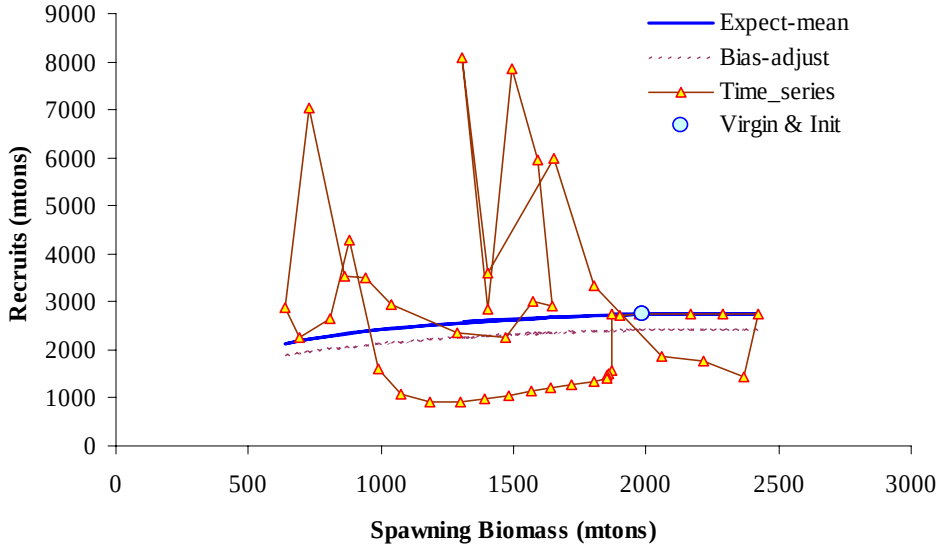
Uncertainty in estimates of stock spawning biomass estimates in the baseline assessment model.

Year	Spawning Biomass	Standard Deviation	CV
1965	1,879	168	0.09
1966	1,865	167	0.09
1967	1,862	167	0.09
1968	1,857	166	0.09
1969	1,808	165	0.09
1970	1,725	163	0.09
1971	1,647	161	0.10
1972	1,572	157	0.10
1973	1,484	151	0.10
1974	1,397	144	0.10
1975	1,305	136	0.10
1976	1,188	126	0.11
1977	1,076	116	0.11
1978	994	106	0.11
1979	884	97	0.11
1980	810	90	0.11
1981	696	85	0.12
1982	642	87	0.14
1983	734	100	0.14
1984	865	107	0.12
1985	943	113	0.12
1986	1,042	121	0.12
1987	1,288	133	0.10
1988	1,472	140	0.10
1989	1,575	141	0.09
1990	1,651	144	0.09
1991	1,594	145	0.09
1992	1,498	148	0.10
1993	1,406	155	0.11
1994	1,312	163	0.12
1995	1,408	189	0.13
1996	1,656	228	0.14
1997	1,806	252	0.14
1998	2,065	290	0.14
1999	2,219	311	0.14
2000	2,376	338	0.14
2001	2,432	352	0.14
2002	2,327	352	0.15
2003	2,201	344	0.16
2004	2,002	329	0.16
2005	1,931	312	0.16

Uncertainty in model estimates of spawning biomass. The baseline model is shown as a solid black line with the emphasis on the CPFV survey CPUE index set at 5. To show the uncertainty in stock size, the emphasis on the CPFV survey CPUE index was also set at a value of 1 (triangles) and 10 (squares).



Recruitment: Recruitments were modeled in this assessment assuming a Beverton-Holt relationship, with steepness fixed at *h*=0.65 and recruitment variability fixed at sigma r = 0.5. Recruitment deviations were estimated for the period 1965-2000. This stock showed evidence of weak recruitment in the 1970s, with peaks in the mid-1980s and mid-1990s. The 1970s time period is not so reliable since length information was not available until the 1980s. Overall, recruitment has been variable throughout the entire time series.



Exploitation status: The gopher rockfish stock north of Point Conception is estimated to be above the precautionary threshold. In addition, recent exploitation rates have been well below the F_{msy} proxy for rockfishes. Recent landings have been between 20% and 60% of the calculated ABC, based on a harvesting rate of $F_{50\%}$.

Management performance: This is the first assessment of gopher rockfish. Gopher rockfish is a federally designated groundfish and part of the *Sebastes* complex managed by the PFMC but has not been managed on an individual species basis.

Forecasts: The gopher rockfish population north of Point Conception was projected under the default PFMC harvest policy (i.e. $F_{50\%}$). Results for changing the emphasis on the CPFV survey CPUE index (1, 5 (baseline), and 10) are presented in the forecast table on the following page.

Decision table: Uncertainty in the stock assessment was based on the emphasis used on the CPFV survey CPUE index in the assessment. To capture the variability in the projection model, the emphasis used for the index was fixed at three levels: 1, 5, and 10. Setting this level at 5 is the baseline model, with 1 and 10 representing the low and high states of nature, respectively. Representatives from the Groundfish Management Team (GMT) requested the first two years in the projections be based on recent averages from the commercial and recreational fisheries. For the commercial fishery, an average based on 2000-2004 was used. The average for the recreational fishery represented the years 2002 and 2004 only.

Research and data needs: The STAR Panel recommended that additional length and age composition data be collected for gopher rockfish throughout California. This would help characterize spatial and possibly temporal variation in growth. An extension of the CPFV survey used in this assessment would be beneficial for updating the CPUE index as well as having a longer time series for this estimate of relative abundance. Discard information for the commercial fishery would also be useful. Future assessments may also want to investigate predator species that have potential in affecting the abundance of the gopher rockfish stock (e.g. lingcod).

Forecasts for gopher rockfish. The baseline model uses emphasis 5 on the CPUE index.

Emphasis on CPUE index = 1

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	1174	862	59.2%	26	5.7%	54	10.7%
2006	1	1147	839	57.6%	26	6.2%	54	11.8%
2007	1	1130	825	56.6%	48	12.5%	105	24.8%
2008	1	1054	751	51.5%	38	12.5%	89	24.8%
2009	1	1011	711	48.8%	33	12.5%	82	24.8%
2010	1	985	689	47.3%	31	12.5%	78	24.8%
2011	1	968	676	46.4%	30	12.5%	76	24.8%
2012	1	956	666	45.7%	29	12.5%	75	24.8%
2013	1	945	657	45.1%	28	12.5%	74	24.8%
2014	1	936	649	44.6%	28	12.5%	73	24.8%
2015	1	929	643	44.1%	28	12.5%	72	24.8%
2016	1	922	637	43.7%	27	12.5%	72	24.8%

Emphasis on CPUE index = 5

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	2385	1931	96.8%	26	2.1%	54	4.7%
2006	1	2304	1850	92.7%	26	2.3%	54	5.1%
2007	1	2235	1781	89.3%	112	10.5%	234	23.9%
2008	1	1931	1480	74.2%	85	10.5%	183	23.9%
2009	1	1736	1292	64.8%	68	10.5%	153	23.9%
2010	1	1609	1174	58.9%	57	10.5%	136	23.9%
2011	1	1525	1099	55.1%	50	10.5%	125	23.9%
2012	1	1466	1049	52.6%	46	10.5%	119	23.9%
2013	1	1422	1011	50.7%	43	10.5%	114	23.9%
2014	1	1387	981	49.2%	42	10.5%	111	23.9%
2015	1	1359	956	47.9%	40	10.5%	108	23.9%
2016	1	1335	935	46.9%	39	10.5%	106	23.9%

Emphasis on CPUE index = 10

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	3058	2533	110.0%	26	1.6%	54	3.5%
2006	1	2940	2414	104.9%	26	1.7%	54	3.9%
2007	1	2836	2310	100.3%	145	9.9%	299	23.5%
2008	1	2409	1883	81.8%	109	9.9%	230	23.5%
2009	1	2131	1611	70.0%	86	9.9%	189	23.5%
2010	1	1949	1439	62.5%	71	9.9%	165	23.5%
2011	1	1827	1329	57.7%	61	9.9%	150	23.5%
2012	1	1742	1255	54.5%	55	9.9%	141	23.5%
2013	1	1681	1201	52.2%	51	9.9%	135	23.5%
2014	1	1633	1160	50.4%	49	9.9%	131	23.5%
2015	1	1595	1126	48.9%	47	9.9%	127	23.5%
2016	1	1563	1098	47.7%	45	9.9%	124	23.5%

Decision table for the gopher rockfish stock assessment model ($F_{50\%}$ and 40:10).

Management Action	Year	Commercial Catch	Recreational Catch	CPUE emph1 least likely (p=0.22) Spawning Biomass	CPUE emph1 Depletion	CPUE emph5 most likely (p=0.40) Spawning Biomass	CPUE emph5 Depletion	CPUE emph10 less likely (p=0.38) Spawning Biomass	CPUE emph10 Depletion
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	48	105	825	56.6%	1781	89.3%	2310	100.3%
	2008	38	89	751	51.5%	1657	83.1%	2153	93.5%
Low	**2009**	33	82	711	48.8%	1576	79.0%	2043	88.7%
Catch	**2010**	31	78	689	47.3%	1519	76.2%	1962	85.2%
	2011	30	76	676	46.4%	1477	74.0%	1900	82.5%
	2012	29	75	666	45.7%	1443	72.3%	1851	80.4%
	2013	28	74	657	45.1%	1415	70.9%	1810	78.6%
	2014	28	73	649	44.6%	1392	69.8%	1776	77.1%
	2015	28	72	643	44.1%	1372	68.8%	1747	75.9%
	2016	27	72	637	43.7%	1354	67.9%	1723	74.8%
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	112	234	825	56.6%	1781	89.3%	2310	100.3%
	2008	85	183	575	39.5%	1480	74.2%	1974	85.7%
Medium	**2009**	68	153	430	29.5%	1292	64.8%	1757	76.3%
Catch	**2010**	57	136	371	25.5%	1174	58.9%	1615	70.1%
	2011	50	125	356	24.5%	1099	55.1%	1522	66.1%
	2012	46	119	345	23.7%	1049	52.6%	1457	63.3%
	2013	43	114	329	22.6%	1011	50.7%	1409	61.2%
	2014	42	111	310	21.3%	981	49.2%	1373	59.6%
	2015	40	108	292	20.1%	956	47.9%	1342	58.3%
	2016	39	106	280	19.2%	935	46.9%	1318	57.2%
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	145	299	825	56.6%	1781	89.3%	2310	100.3%
	2008	109	230	487	33.4%	1389	69.6%	1883	81.8%
High	**2009**	86	189	358	24.6%	1147	57.5%	1611	70.0%
Catch	**2010**	71	165	369	25.3%	998	50.0%	1439	62.5%
	2011	61	150	350	24.0%	905	45.4%	1329	57.7%
	2012	55	141	343	23.5%	845	42.3%	1255	54.5%
	2013	51	135	319	21.9%	799	40.1%	1201	52.2%
	2014	49	131	300	20.6%	762	38.2%	1160	50.4%
	2015	47	127	283	19.4%	729	36.6%	1126	48.9%
	2016	45	124	275	18.9%	701	35.1%	1098	47.7%

First two years were based on GMT recommendations:
Commercial - the average for the last 5 years (2000-2004) = 26 mtons.
Recreational - the average for 2002 and 2004 only = 54 mtons.

< 40%